

## **REMARKS**

In view of the above amendments and following remarks, reconsideration and further examination are requested.

Claims 21-23, 26, 27, 33-38, 40-43 and 45-53 were rejected over prior art for variety of reasons, and claims 24, 25, 28-32, 39 and 44 were objected to as being dependent upon a rejected base claim, but were indicated to be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

In view of the above actions taken by the Examiner, claims 21 and 45 have been amended to further distinguish the instant invention from the references relied upon, allowable claims 24, 28, 30, 39 and 44 have been rewritten in independent form as new claims 54-58, respectively, and claims 25, 29, 31 and 32 have been amended so as to not depend from cancelled claims. Independent claims 42 and 52 have not been amended. For reasons to follow it is respectfully submitted that amended claims 21 and 45 and non-amended claims 42 and 52, along with their dependent claims, are allowable over the references relied upon.

### **The Rejections Based on Horiike et al.**

Claims 21, 22, 33, 35 and 45-48 were rejected under 35 U.S.C. § 102(b) as being anticipated by Horiike et al., and claims 34, 42 and 43 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Horiike et al. Each of independent claims 21, 42 and 45 are believed to be allowable over Horiike et al. for the following reasons.

Claims 21 and 45 have been amended to further distinguish from Horiike et al. In this regard, claims 21 and 45 now require that the surface treatment gas is to be brought into contact with the substrate simultaneously with irradiating the substrate with a fast particle beam.

Specifically, claim 21 recites a method that includes *inter alia*

**while bringing said surface treatment gas into contact with said surface of said substrate, irradiating said surface of said substrate with a fast particle beam (emphasis added).**

Similarly, claim 45 recites an apparatus that includes *inter alia*

a fast particle beam device for generating a fast particle beam...

and directing a generated fast particle beam to a surface of a substrate so as to irradiate the surface with the generated fast particle beam, **while bringing the gas into contact with the surface of the substrate** (emphasis added).

Neither the method of claim 21 nor the apparatus of claim 45 is anticipated by Horiike et al. In this regard, as described in section IV (DIGITAL ETCHING OF Si) of this article, etching occurs by performing three separate steps at different times. Specifically, the first step is adsorption of an etching gas by a substrate, the second step is reacting this adsorbed gas with material of the substrate via photoexcitation, for example, and the third step is desorption of the reacted material of the substrate via irradiating Ar<sup>+</sup> ions generated by electron cyclotron resonance plasma. Thus, while Horiike et al. does bring a surface treatment gas into contact with a substrate, and does irradiate the surface of the substrate with a particle beam, these two operations are not performed simultaneously, but rather are performed sequentially.

Accordingly, claims 21 and 45 are allowable over Horiike et al.

With regard to claim 42, this claim requires that bringing a gas into contact with a substrate results in removal of substrate material. In this regard, claim 42 recites a method that includes *inter alia*

**bringing into contact with a surface of a substrate a gas that reacts well with material of said substrate such that a chemical reaction between said material of said substrate and said gas results in a compound being formed, which compound includes a component element of said material of said substrate, whereby said material of said substrate is removed from said surface of said substrate** (emphasis added).

Such a method is not taught or suggested by Horiike et al.

In this regard, as expressed previously, the etching of Horiike et al. results from performing three distinct operations; namely, a gas adsorption operation, a chemical reaction operation and a desorption operation. The material of the substrate is not removed until performance of the desorption operation. Thus, contrary to what is required by claim 42, the adsorption operation of Horiike et al., i.e. the bringing of a gas into contact with the substrate, does not by itself result in material of the substrate being removed. Rather, this adsorption of gas is merely a precursor to removal of substrate material.

Accordingly, claim 42 is also allowable over Horiike et al.

**The Rejections Based on Mizutani et al.**

Claims 21, 22, 33, 35-37, 40, 45, 46 and 48-50 were rejected under 35 U.S.C. § 102(b) as being anticipated by Mizutani et al., and claims 34, 41, 47 and 51 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Mizutani et al.

Claims 21 and 45 have been amended to further distinguish from Mizutani et al. In this regard, claims 21 and 45 now require that the surface of the substrate is irradiated with a beam other than a neutral beam.

Specifically, claim 21 recites a method that includes *inter alia*

irradiating said surface of said substrate with a fast particle beam,  
**other than...a neutral beam** (emphasis added).

Similarly, claim 45 recites an apparatus that includes *inter alia*

a fast particle beam device for generating a fast particle beam,  
**other than...a neutral beam** (emphasis added).

In Mizutani et al., low-energy neutral beams and neutral radicals are simultaneously supplied to a specimen during etching, and reactions are enhanced by neutral beam bombardment. Accordingly, because each of claims 21 and 45 now preclude a neutral beam, claims 21 and 45 are allowable over Mizutani et al.

**The Rejections Based on Hatakeyama et al. '416**

Claims 21, 22 and 45-51 were rejected under 35 U.S.C. § 102(b) as being anticipated by Hatakeyama et al. '416. This rejection is respectfully traversed for the following reasons.

Claim 21 requires that a surface treatment gas is brought into contact with a substrate. In this regard, claim 21 recites a method that includes *inter alia*

bringing a surface treatment gas into contact with a surface  
of the substrate.

In Hatakeyama et al. '416, object 4 is not contacted by any gas. Specifically, with regard to the embodiment of Figure 1, the object is subjected to a fast atom beam 3 and radical particles 9. While

the fast atom beam and the radical particles may be formed from a gas, they are themselves not a gas. Similarly, with regard to the embodiment of Figure 2, object 4 is subjected to a fast atom beam 3 ,formed from a gas, and light energy 11; however, neither the fast atom beam nor the light energy is a gas. Accordingly, claim 21 is not anticipated by Hatakeyama et al. '416.

Similarly, claim 45 recites an apparatus that includes *inter alia*  
a first source for supplying a gas into said reactor housing.

As discussed previously with regard to claim 21, Hatakeyama et al. '416 does not subject the object 4 to a gas. This is so because no gas is supplied into container 2, and accordingly, Hatakeyama et al. '416 does not disclose or suggest a source for supplying a gas into a housing as required by claim 45. Thus, claim 45 is also not anticipated by Hatakeyama et al. '416.

#### **The Rejections Based on Phaneuf et al.**

Claims 21-23, 26, 35-38, 45, 46, 48 and 49 were rejected under 35 U.S.C. § 102(e) as being anticipated by Phaneuf et al., and claims 27, 47 and 51 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Phaneuf et al. These rejections are respectfully traversed for the following reasons.

While Phaneuf et al. discloses directing a gas towards a workpiece, this gas is used to generate a sacrificial layer via decomposition of the gas, and then a focused ion beam is irradiated onto this sacrificial layer such that the sacrificial layer is removed along with material of the workpiece. Thus, not only is the gas and beam of Phaneuf et al. not applied simultaneously as required by claims 21 and 45, but also irradiation of the substrate with the ion beam of Phaneuf et al. does not "facilitate a reaction between the surface and the surface treatment gas" as recited in claim 21. Accordingly, claim 21 is not anticipated by Phaneuf et al. For analogous reasons, claim 45 is not anticipated by Phaneuf et al.

#### **The Rejections Based on Hatakeyama et al. '470**

Claims 52 and 53 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Hatakeyama et al. '470. This rejection is respectfully traversed for the following reasons.

In rejecting claim 52 as being obvious over Hatakeyama et al. '470, the Examiner expressed that it would have been obvious to employ any of a variety of FAB electrode diameters and FAB electrode spacing in the apparatus of Hatakeyama et al. '470, including those as recited in claims 52 and 53. However, though HCl gas is employed in the device of Hatakeyama et al. '470, the purpose of this gas is different from the gas utilized in the present invention. That is, the HCl gas of Hatakeyama et al. '470 is used for generating the FAB, whereas the gas of the instant invention is brought into contact with a surface of a substrate so as to facilitate a reaction of the substrate. The main object of Hatakeyama et al. '470 is to control an atom beam characteristic, which is different from the main object of the instant invention.

Accordingly, because of these differences between Hatakeyama et al. '470 and the instant invention, it is respectfully submitted that one having ordinary skill in the art would not have sought to modify the diameters of, and spacing between, the electrodes of Hatakeyama et al. '470 as done with regard to the instant invention. Thus, claims 52 and 53 are allowable over Hatakeyama et al. '470.

Thus, claims 21-23, 26, 27, 33-38, 40-43 and 45-53 are allowable over the references relied upon by the examiner.

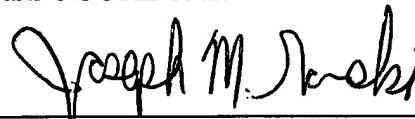
In view of the above amendments and remarks, it is respectfully submitted that the present application is in condition for allowance and an early Notice of Allowance is earnestly solicited.

If after reviewing this Amendment, the Examiner believes that any issues remain which must be resolved before the application can be passed to issue, the Examiner is invited to contact the Applicants' undersigned representative by telephone to resolve such issues.

Respectfully submitted,

Naoaki OGURE et al.

By:



Joseph M. Gorski  
Registration No. 46,500  
Attorney for Applicants

JMG/edg  
Washington, D.C. 20006-1021  
Telephone (202) 721-8200  
Facsimile (202) 721-8250  
August 9, 2004